

U.S. Patent Application Serial No. 09/881,836  
Response dated January 21, 2004  
Reply to OA of October 21, 2003

**IN THE CLAIMS**

Please cancel claims 1-4 and 6 without prejudice or disclaimer.

Please add new claims 7-11 as follows:

**Claim 1-4 (Canceled).**

**Claim 5 (Withdrawn):** A process for growing doubly doped lithium niobate crystal as claimed in anyone of Claims 1-4, wherein said process includes the following steps:

(1) Weigh up high purity  $\text{Li}_2\text{CO}_3$ ,  $\text{Nb}_2\text{O}_5$ ,  $\text{Fe}_2\text{O}_3$  and  $\text{MgO}$ ,  $\text{In}_2\text{O}_3$  or  $\text{ZnO}$  powders according to the crystal composition, and dry them at  $120\sim 150^\circ\text{C}$ , then thoroughly mix them lasting for 24 hours, and keep them at  $800\sim 850^\circ\text{C}$  for 2~5 hours to make  $\text{Li}_2\text{CO}_3$  decompose sufficiently, and then sinter at  $1050\sim 1150^\circ\text{C}$  for 2~8 hours to obtain doubly doped lithium niobate powder.

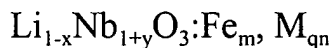
(2) Put the above doped lithium niobate powder into a Pt crucible after impacted, then heat the powder by a middle frequency stove; Grow the doubly doped lithium niobate crystals using the Czochralski pulling method along c or a axis via the procedures of necking, shouldering, uniform-diametering, and tailing, with the pulling rate being 1~3 mm/h, the rotation rate being 15~30 rpm, the temperature difference of the melt-crystal interface being  $20^\circ\text{C}$ , the temperature gradient in the melt volume near the surface being  $1.5^\circ\text{C}/\text{mm}$ , the temperature gradient above the melt surface being  $1.0^\circ\text{C}/\text{mm}$ , respectively.

(3) Pole and anneal the grown doped lithium niobate crystals at  $1200^\circ\text{C}$  to obtain single-domained doubly doped lithium niobate crystals.

**Claim 6 (Canceled)**

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**Claim 7 (New):** A doubly doped lithium niobate crystal, comprising:



where, M is a member selected from the group consisting of Mg, Zn, and In, provided when M is Mg or Zn,  $q=2$ , and when M is In,  $q=3$ ;

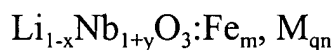
x is in the range of  $0.05 \leq x \leq 0.13$ ;

y is in the range of  $0.00 \leq y \leq 0.01$ ;

m is in the range of  $5.0 \times 10^{-5} \leq m \leq 7.5 \times 10^{-4}$ ; and

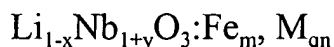
qn is in the range of  $0.02 \leq qn \leq 0.03$ .

**Claim 8 (New):** The doubly doped lithium niobate crystal as claimed in claim 7, said



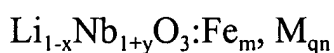
is doped with 0.007 to 0.03 wt% Fe, and M is 1.0 to 5.0 mol% Mg, where the congruent composition is  $[\text{Li}]/[\text{Nb}] = 0.90:0.95$ .

**Claim 9 (New):** The doubly doped lithium niobate crystal as claimed in claim 7, said



is doped with 0.01 to 0.05 wt% Fe, and M is 0.75 to 3.0 mol% In, where the congruent composition is  $[\text{Li}]/[\text{Nb}] = 0.91:0.95$ .

**Claim 10 (New):** The doubly doped lithium niobate crystal as claimed in claim 7, said



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is doped with 0.02 to 0.06 wt% Fe, and M is 1.5 to 6.5 mol% Zn, where the congruent composition is  $[\text{Li}]/[\text{Nb}] = 0.87:0.95$ .

**Claim 11 (New):** A three-dimensional optical storage material, comprising the doubly doped lithium niobate crystals as claimed in any one of claims 7-9 or 10.